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ABSTRACT

In June 1993 the "Wall Street Journal" carried a table of data prepared by the Heritage Foundation that listed the states in order of the average amount they expend on each public school student. The table also contained each state's rank on the average score on the Scholastic Aptitude Test (SAT) and the rank of each state in the average performance of a random sample of eighth graders on the mathematics portion of the National Assessment of Educational Progress (NAEP). The obvious inference drawn from this table was that spending money on education does not improve student performance, since some states that spent a great deal did not have high performance indices. Any such broad inference is almost surely specious. Setting aside such considerations as the differing cost of living, one issue is examined: self-selection. Average performance on the SAT does not represent study proficiency in that state, since only a small percentage of students take the SAT in some states. The uncertainty within a state about who takes the SAT is too great an obstacle for statistical adjustment to overcome. NAEP scores, which are closer to being the sort of random sample that is required for meaningful comparisons, are a more reasonable measure, and when they are examined with expenditures, there is a small relationship that indicates that spending money does improve performance. For every thousand dollars spent a state's NAEP ranking improves by two places. The reproduced table and two figures illustrate the discussion. (SLD)

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Does spending money on education help?
A reaction to the Heritage Foundation and the *Wall Street Journal*

Howard Wainer
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On Tuesday, June 22nd 1993, the *Wall Street Journal* carried a table of data prepared by the Heritage Foundation. It lists all of the states in order of the average amount that they expend on each public school pupil. Secondly, the table contains each state's rank on the average score on the Scholastic Aptitude Test (SAT) obtained by combining equally the SAT-Verbal and SAT-Mathematical scores for those students in that state who opted to take that exam. Last, it shows the rank of each state in the average performance of a random sample of their 8th grade students on the mathematics portion of the National Assessment of Educational Progress (NAEP).

Insert Table 1 About Here

It was observed that some states (like New York, New Jersey and Connecticut) that have a high average per pupil expenditure don't rank very highly on the performance indices, and that conversely other states (like North Dakota and Iowa) that spend much less do very well indeed. The obvious inference is that spending money on education does not improve students' performance. Indeed quite the opposite. Is this inference borne out by the data presented?

Shown in Figure 1 is a plot of Per pupil Expenditure vs. State Ranks on average SAT scores. We see a strong relationship. It appears that a state's SAT ranking worsens

by almost 6 places for every thousand dollars that was spent on the average pupil. What inferences can be drawn from this observation?

Insert Figure 1 About Here

I believe that any broad inferences drawn from this observation are almost surely specious. An obvious concern is uncertainty about the direction of the causal arrow. For example would anyone, even from the Heritage Foundation, upon viewing a similar plot that showed the positive relationship between money spent on medical care and mortality rate conclude that the way to a longer life is to reduce medical spending?

Setting aside the logical difficulties with this inference there are so many other problems with these data that trying to even describe them would lengthen this note far beyond its purpose. There is an extensive scientific literature surrounding it and interested readers can begin in a recent review paper (Wainer, 1989) and follow the topic from the work referenced therein. In this discussion I will ignore the obvious problems associated with:

1. Differences in the cost of living between states. Does a dollar buy the same amount of anything in Alaska as it does in North Carolina?

2. Using a state as the unit of discussion. Is the average per pupil expenditure the same in Manhattan as it is in Utica?

3. Differences associated with the costs of education associated with various demographic mixtures. Do we expect to get the same SAT return on every dollar in a population heavy with recent Asian or Hispanic immigrants as we would in one whose native language is English?

4. Comparing one measure that averages over all individuals in a state (per pupil expenditures) with another that averages over a distinctly nonrandom subsample (SAT scores).

Although all of these unaddressed issues can (and do) make inferences from such a gross comparison completely specious, I will ignore them here and focus attention on just one issue: self-selection.

Average performance on the SAT in a state does not represent the students' proficiency in that state. In some states only a very small percentage of students opt to take it, in others a large proportion do. In Iowa only 3% whereas in Connecticut 78%. If we chose the top 3% from the Connecticut SAT-takers their average scores would smother the currently top-ranked Hawkeyes. Are the 3% of Iowan high school seniors who take the SAT the best that Iowa has to offer? Who knows? I wouldn't make book on it, but we have no evidence. What would Iowa's rank be if 78% of their students took the test? Almost surely lower, but how much so? It is clear that examining the raw ranks will not get us anywhere. There have been many attempts to adjust these ranks statistically but none were successful .

The uncertainty associated with who within a state decides to take the SAT has, so far, proven to be too great an obstacle for statistical adjustment to overcome. The uncertainty associated with self-selection yields bounds that are too broad for any useful purpose. In one study Connecticut's adjusted SAT rank was 1 and in another it was 35. Although the portion of the population sampled by the SAT is an important one, it is too poorly defined and insufficiently representative to be of any use in the sorts of comparisons suggested by the Heritage Foundation.

NAEP scores are different. They are closer to being the sort of random sample that is required for meaningful comparisons. Of course the rankings given were for 8th

graders not seniors, and they were for just mathematics, but they are a reasonable sample. A comparison of the state ranks based on NAEP scores with those based on SAT scores reveals that the relationship between the two, though positive, is very weak. Knowing a state's ranking on one measure helps to dissipate only 10% of one's uncertainty of that state's ranking on the other.

I do not view this as a shortcoming of the NAEP scores as a measure of a state's performance. Rather it puts an explicit limit on the value of mean SAT scores as an educational indicator.

Interestingly, if we use the more reasonable NAEP rankings as the dependent variable in trying to assess the relationship between average Per Pupil Expenditures and student performance we find a small relationship in a direction opposite that suggested by the Heritage Foundation. That for every thousand dollars spent a state's NAEP ranking improves by two places.

Insert Figure 2 About Here

I have not attempted to adjust statistically the estimates of the relationship between money spent and student performance, although it is certain that such adjustments would increase the size of the observed effect. My goal here was merely to indicate that the NAEP rankings are a more suitable dependent variable for such comparisons, and that even in the grossest possible kind of comparison we have seen that spending money is related to higher scores.

Table 1

Money Doesn't Help

This table, produced by the Heritage Foundation, compares the dollars spent per student in each state with that state's ranking according to 1992's Scholastic Aptitude Test and eighth-grade National Assessment of Educational Progress math scores. Many states with consistently high test scores spend well below average per pupil on education. In contrast, the states that spend the most have among the lowest test scores.

	AVG. PER PUPIL EXPENDITURE	SAT RANK	NAEP RANK
New Jersey	$9,159	39	14
New York	8,500	42	22
District of Columbia	8,210	49	42
Connecticut	7,914	35	11
Alaska	7,877	31	N.A.
Rhode Island	6,989	43	23
Pennsylvania	6,534	45	14
Massachusetts	6,351	33	12
Maryland	6,184	32	25
Delaware	6,016	37	27
Wisconsin	5,946	7	6
Maine	5,894	41	4
Vermont	5,740	36	N.A.
Ohio	5,639	24	18
New Hampshire	5,584	28	4
Virginia	5,360	38	18
Oregon	5,291	26	N.A.
Minnesota	5,260	3	3
Michigan	5,257	20	18
Wyoming	5,255	21	8
Montana	5,184	19	N.A.
Florida	5,154	40	31
Illinois	5,062	10	N.A.
Indiana	5,051	47	17
West Virginia	5,046	27	34
Washington	5,045	30	N.A.
Kansas	5,009	6	N.A.
Hawaii	5,008	44	37
Georgia	4,860	50	31
Iowa	4,839	1	1
California	4,826	34	29
Colorado	4,809	23	12
North Carolina	4,802	48	34
Nevada	4,564	29	N.A.
New Mexico	4,448	15	31
Missouri	4,415	13	16
Kentucky	4,390	18	28
Nebraska	4,381	8	6
South Carolina	4,327	51	29
Texas	4,238	46	25
Arizona	4,231	25	23
Louisiana	4,012	16	40
Oklahoma	3,742	11	18
South Dakota	3,730	5	N.A.
Tennessee	3,707	9	34
North Dakota	3,685	2	1
Alabama	3,648	14	39
Arkansas	3,334	17	38
Mississippi	3,322	12	41
Idaho	3,200	22	8
Utah	2,993	4	8
Nat'l Average	**$5,261**	–	–

N.A. = state does not participate. Sources: Heritage; Department of Education; College Board.

Source: *The Wall Street Journal*
Page A14, June 22, 1993

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Figure Captions

Figure 1. Plotting average within state Per Pupil Expenditures on education against the rank of each state based on its average SAT score seems to support the Heritage Foundation's inference that "Money Doesn't Help."

Figure 2. When state NAEP ranks are compared with average within state Per Pupil Expenditures on education a small positive effect is clear.

A state's SAT rank worsens by six places for every thousand dollars spent on students

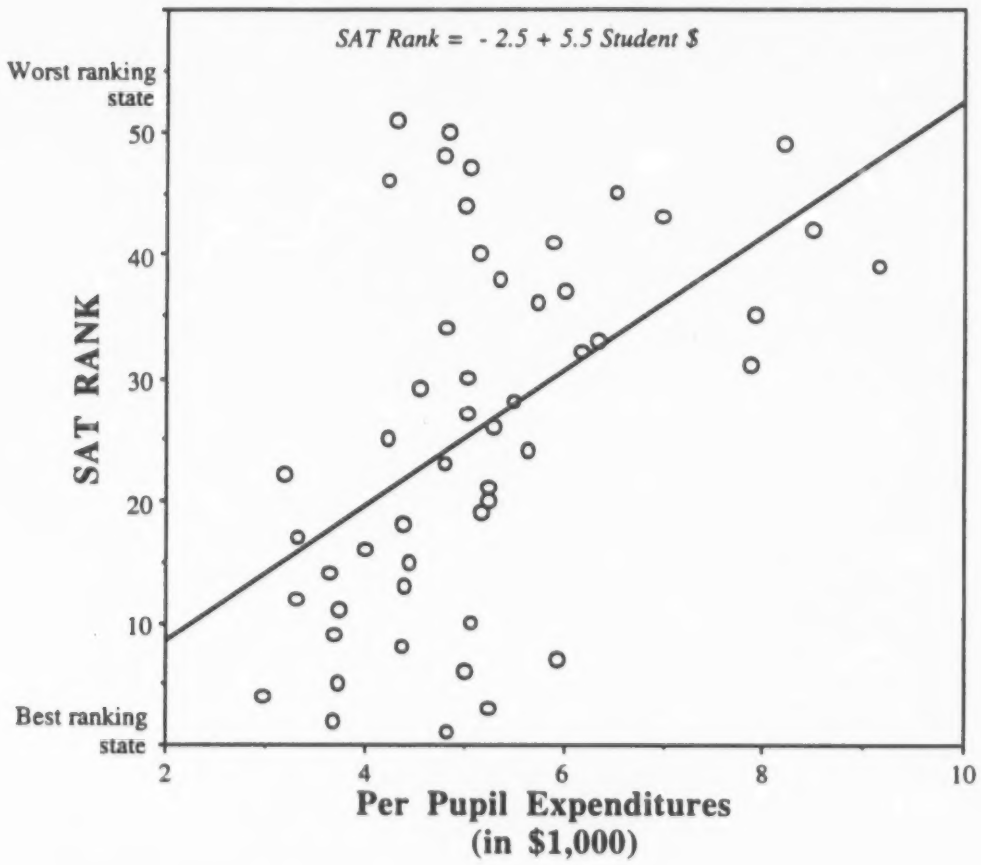

Figure 1

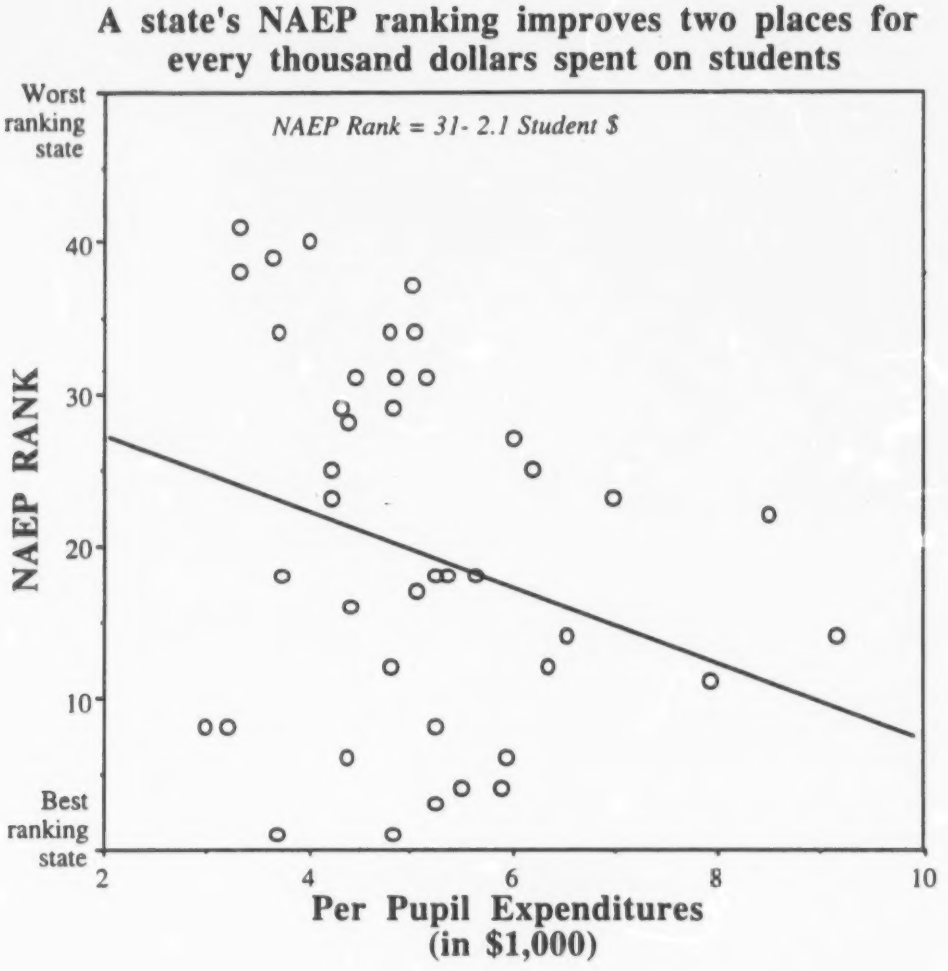
A state's NAEP ranking improves two places for every thousand dollars spent on students
NAEP Rank = 31- 2.1 Student $
Worst ranking state
Best ranking state
NAEP RANK
40
30
20
10
2
4
6
8
10
Per Pupil Expenditures (in $1,000)

Figure 2